D E C L A R A T I O N

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Signed this 6th day of January, 2003

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PATENT OFFICE

JAPANESE GOVERNMENT

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Date of Application : February 18, 2000

Application Number : Japanese Patent Application No. 2000-041127

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January 26, 2001

Commissioner,

Patent Office Kozo, OIKAWA (SEAL)

(Certificate No. 2001-3000182)

Patent Application No.2000-041127

[Name of Document] Patent Application
[Reference Number] P99425SC
[Date of Submission] February 18, 2000
[Addressee] Commissioner, Patent Office
[International Patent Classification] B29C 39/10
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[Indication of Fee]
[Prepayment Register Number] 074403
[Amount of Payment] ¥21,000-
[List of Articles Filed]
[Name of Article] Specification・・・・1
[Name of Article] Drawings・・・・・・・1
[Name of Article] Abstract・・・・・・・1

[Name of Document] SPECIFICATION

[Title of the Invention] FOAMED THERMOPLASTIC RESIN ARTICLE

[Claims]

[Claim 1]

A foamed thermoplastic resin article obtained by forming and simultaneously integrally laminating a skin material and a foamed thermoplastic resin base material, wherein the foamed thermoplastic resin base material is composed of a foamed core layer, a skin layer of the skin material side and a skin layer of the backside, and wherein a relationship of A<B is satisfied where the thickness of the skin layer of the skin material side is defined as A and the thickness of the skin layer of the backside is defined as B.

[Claim 2]

The foamed thermoplastic resin article according to claim 1, wherein the skin material has a cushion layer having a compressive elastic modulus of not more than 0.3 MPa on its backside.

[Claim 3]

The foamed thermoplastic resin article according to claim 1 or 2, wherein the relationship between the thickness A of the skin layer of the skin material side and the thickness B of the skin layer of the backside is $A \leq 0.8B$.

[Claim 4]

The foamed thermoplastic resin article according to any

one of claims 1 to 3, wherein the A is not more than 1 mm.

[Claim 5]

The foamed thermoplastic resin article according to any one of claims 1 to 4, wherein the thermoplastic resin is a polypropylene-based resin.

[Claim 6]

The foamed thermoplastic resin article according to any one of claims 1 to 5, wherein the polypropylene-based resin has a melt flow rate of not less than 15.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention Pertains]

The present invention relates to a foamed thermoplastic resin article, and more specifically to a foamed thermoplastic resin article having a light weight and a high stiffness suitable for interior members for automobiles, as well as having soft feel of its skin layer.

[0002]

[Prior Art]

Thermoplastic resin articles formed by injection-molding a thermoplastic resin and laminating a skin material have conventionally been used in the fields of interior members for automobiles and the like, but these articles have high densities and thus have large weights, so that weight reduction of these articles has been requested especially in

the field of interior materials for automobiles.

[0003]

For achieving the weight reduction of interior materials of automotive parts by using a thermoplastic resin and forming the inner layer thereof with a foamed resin, known is a method such that a skin material is placed between a pair of female and male mold halves; the interval between the mold halves (cavity clearance) is set at a predetermined value; a polypropylene resin composition containing a foaming agent is introduced between the skin material and the female mold half and simultaneously the mold halves are closed, thereby forming the resin into a predetermined shape and integrating the resin with the skin material; the mold halves are opened by a predetermined interval, thereby causing a core portion of the resin to foam; and then the resultant article is cooled (JP, A 6-344362).

[0004]

[Problem to be Solved by the Invention]

However, in the case of articles in which a skin material and a thermoplastic resin base material are integrally laminated together such as that disclosed in the above-mentioned JP, A 6-344362, although it is possible to achieve weight reduction, it is impossible to satisfy, at the same time, both requirements: soft feel of skin materials and increased stiffness as articles.

[0005]

In other words, in conventionally known articles such as that disclosed in the above patent publication, skin layers (solidified layers) having the same thickness are formed on both the skin material side and the backside of a thermoplastic resin base material, and the stiffness and weight reduction are balanced mainly by adjusting the thickness of these skin layers.

[0006]

For this reason, there is a problem in that when attempt is made to obtain an article of high stiffness, the skin layers on both sides become thick so that soft feel of the skin material of the article becomes insufficient, whereas when attempt is made to obtain a sufficient soft feel of the skin material, the skin layers on both surfaces become thin and therefore the stiffness of the article becomes poor.

[0007]

The present invention solves the above-mentioned problem and provides an article comprising a skin material and a foamed thermoplastic resin base material laminated and integrated together wherein the article has a light weight and a high stiffness and wherein the layer of the skin material has a soft feel.

[0008]

[Means for Solving the Problem]

The present invention provides a foamed thermoplastic resin article formed by integrally laminating a skin material and a thermoplastic resin foamed base material while forming the same,

wherein the thermoplastic resin foamed base material is composed of a foamed core layer, a skin layer of the skin material side and a skin layer of the backside, and when thickness of the skin layer of the skin material side is defined as A, and thickness of the skin layer of the backside is defined as B, the A and B satisfy the relationship of A<B.

[0009]

With the configuration that the foamed core layer, the skin layer of the skin material side, and the skin layer of the backside are provided and that thickness A of the skin layer of the skin material side on which the skin material is laminated and thickness B of the skin layer of the backside satisfy the relationship A<B, it is possible to obtain a foamed thermoplastic resin article which has a soft feel in its skin material layer and at the same time satisfies the requirements of being of light weight and high stiffness. It is preferred that the expansion ratio of the foamed core layer is not less than 2 times, and specifically not less than 3 times from the viewpoint of weight reduction of the article.

[0010]

In the above-mentioned foamed thermoplastic resin

article, it is preferable that the skin material has, on its backside, i.e., its side where it is laminated with the resin, a cushion layer having a compressive elastic modulus of not more than 0.3 MPa.

[0011]

When the cushion layer is formed between the skin material and the resin layer, it is possible to obtain easily a foamed thermoplastic resin article in which the feel of the skin material layer is softer.

[0012]

The above-mentioned compressive elastic modulus of the cushion layer is the initial elastic modulus of the constituent material of the cushion layer when it is compressed with a disc 50 mm in diameter at a compression speed of 1mm/min.

[0013]

In the above-mentioned invention, it is more preferable that the relationship between the thickness A of the skin layer of the skin material side and the thickness B of the skin layer of the backside is $A \leq 0.8B$ because a foamed thermoplastic resin article having a soft feel in its skin material layer can be formed with a higher reliability.

[0014]

Furthermore, in order to maintain the soft feel of the soft skin material layer, the thickness A is preferably not more than 1 mm regardless of the thickness of the panel.

[0015]

The thermoplastic resin that forms the foamed thermoplastic resin article of the present invention is a polyolefin-based resin, particularly a polypropylene-based resin because a foamed thermoplastic resin article with a high strength and a high stiffness at a low cost.

[0016]

As the polypropylene-based resin, polypropylene-based resins having a melt flow rate (MFR) of not less than 15, preferably not less than 25 are particularly used.

[0017]

By using a polypropylene-based resin having an MFR in the above-mentioned range, it is possible to prevent foams from being collapsed and form a foamed core layer reliably. As a result, it is possible to obtain a foamed thermoplastic article with a light weight and a high stiffness which satisfies the above described $A<B$, more preferably $A \leq 0.8B$ and which has a soft feel in its skin material layer.

[0018]

The foamed thermoplastic resin article of the present invention can be used suitably in the field of automotive interior parts, for example, instrument panels, seat backs, partition boards, console boxes, door trims and the like.

[0019]

[Mode of Carrying out the Invention]

Embodiments of the present invention will be described with reference to drawings.

In Fig. 1, show is an example of a partial cross-sectional shape of a foamed thermoplastic resin article (hereinafter, referred simply to as a panel).

A panel 1 comprises a skin material 3 and a foamed thermoplastic resin layer 10 laminated together. The foamed thermoplastic resin layer 10 is composed of a skin layer of the skin material side 5, a skin layer of the backside 7 and a foamed core layer 9. When the thickness of the skin layer of the skin material side 5 is defined as A and the thickness of the skin layer of the backside 7 is defined as B, the relationship A < B is satisfied. The thickness of the skin layer is represented by C.

[0020]

The shape of the panel of the present invention is not limited to a two-dimensional shape, but may be a curved surface in accordance with the application of the panel, or may be a three-dimensional shape such as automotive interior materials. In the following, an example where a three-dimensional panel in which a skin material layer is laminated to form a surface is manufactured will be described with reference to Fig. 2. In the manufacture of the panel, paired female and male mold halves composed of a female mold half 23 and a male mold half 25 fixed on a base 26 wherein the cavity clearance (t) can be

set arbitrarily are used.

[0021]

The skin material 30 is held with a clamper 28 and the end surface of the male mold half 23 (See Fig. 2(a)). The holding of the skin material 30 with the clamper 28 is achieved so that the skin material 30 can slide when it is drawn into the recess portion of the mold during the molding.

[0022]

Next, at least one of the female mold half 23 and the male mold half 25 is moved to create a clearance for starting resin supply. The clearance for starting resin supply is set appropriately. If the clearance is too wide, foaming of the resin will occur rapidly to result in a situation where the foaming agent is released and foams are formed insufficiently. It is preferable that the clearance for starting resin supply is less than (C + 5) mm wherein the thickness of the skin material 30 is represented by C because the release of the foaming agent can be prevented and a foamed core layer with a high expansion ratio can be formed easily.

[0023]

The step shown in Fig. 2(b) is a step of introducing a molten thermoplastic resin 33 containing a foaming agent through a resin supply path 32. In this embodiment, three branch paths 32B of the resin supply path 32 are formed. However, the number of branch paths 32B is not limited to three and may be set

arbitrarily according to the shape and size of the article.

[0024]

After introducing a predetermined amount of the molten thermoplastic resin 33 containing a foaming agent, compression is performed so that the cavity clearance of the mold halves becomes not greater than a predetermined thickness of the article, and under this condition, a skin layer of the resin is cooled to form a skin layer of the resin. Through this compression step, the skin material and the resin layer are adhered together. The cooling time for forming the skin layer is set appropriately in consideration of the thickness of the article, the temperature of the mold halves and the like. When taking practically applicable conditions for reducing the forming time and the like into consideration, a cooling time of from about 1 to 30 seconds is preferred.

[0025]

Next, the mold halves are opened so that the cavity clearance becomes a predetermined thickness of the article, the resin between the skin layers is allowed to expand to form a foamed core layer, whereby a panel-like foamed thermoplastic resin article which is a final product is obtained.

[0026]

During the forming, the compression speed of the cavity clearance defined by the mold halves is preferably from 1 to 50 mm/sec and the compression is performed by causing the female

and male mold halves to move relative to each other. With respect to the pair of female and male mold halves, one of the mold halves may be moved or alternatively both of the mold halves may be moved as necessary. Furthermore, the introducing pressure of the molten thermoplastic resin is preferably from 0.5 to 50 MPa.

[0027]

As the thermoplastic resin used in the present invention, resins that have conventionally been used for automotive interior members may be used without limitation and examples thereof include polyolefin-based resins such as polypropylene-based resins and polyethylene-based resins, acrylic resins such as polystyrene-based resins and poly(methyl methacrylate) resin, ABS, polyamide resins such as nylon-6, polyester resins, polycarbonate resins and polyphenylene ether resins. Among these resins, use of polypropylene-based resins is preferable from the viewpoints of the formability, cost and mechanical strength. Particularly preferred are polypropylene-based resins having a melt flow rate (MFR) of not less than 15.

[0028]

As the foaming agent to be added to the thermoplastic resin, known foaming agents used in production of thermoplastic resin foams may be used. Specifically, inorganic foaming agents such as sodium hydrogencarbonate, ammonium

hydrogencarbonate and ammonium carbonate, and foaming agents such as nitroso compounds such as N,N'-dinitrosopentamethylenetetramine, azo compounds such as azodicarbonamide and azobisisobutyronitrile, sulfonylhydrazides such as benzenesulfonylhydrazide, toluenesulfonylhydrazide, diphenylsulfone-3,3'-disulfonylhydrazide, p-toluenesulfonylsemicarbazide and the like can be used as a foaming agent. Salicylic acid, urea or a foaming aid containing the same may be added as necessary.

[0029]

The kind of the foaming agent may be selected by taking the melting temperature of the thermoplastic resin to be used and the objective expansion ratio and the like into consideration. Furthermore, the amount of the foaming agent added is adjusted in consideration of the strength, density and the like of the objective article, and is generally from 0.1 to 5 parts by weight with respect to 100 parts by weight of the thermoplastic resin to be used.

[0030]

As the skin material of the panel-like foamed thermoplastic resin article of the present invention, known skin materials may be used with no limitation. Specific examples of the skin material include woven fabric, non-woven fabric, knitted fabric, films and sheets formed of a

thermoplastic resin or thermoplastic elastomer, and the like. In addition, composite skin materials in which non-foamed or foamed sheets of polyurethane, rubber, thermoplastic elastomer or the like are laminated on the above-mentioned skin materials may be used.

[0031]

Examples of the material forming the cushion layer include polyurethane foam, EVA foam, PP foam, PE foam and the like, and polyurethane foam is most preferable because it can easily form a material having a small compression set and a compression elastic modulus of not more than 0.3 MPa. Furthermore, the cushion layer may be lined with a sheet or film of woven fabric, non-woven fabric, knitted fabric, sheets or films of thermoplastic resin or thermoplastic elastomer as the protection layer of the cushion layer.

[0032]

[Examples]

An example that shows the constitution and effect of the present invention specifically is illustrated by referring to the forming performed by mounting a pair of female and male mold halves shown in Fig. 2 to a presser having a mold clamping force of 500 tons.

[0033]

As a skin material, used was that of triple-layered structure comprising a 0.5-mm-thick polyolefin-based

thermoplastic elastomer sheet which has thereon a 4-mm-thick foamed polyurethane layer having a compression elastic modulus of 0.2 MPa and which also has a 0.2 mm-thick non-woven fabric having a weight of 50g/m^2 as a backing layer.

[0034]

Furthermore, as an expandable thermoplastic resin which is to become a core material, 100 parts by weight of a polypropylene (Sumitomo Noblen AZ564 manufactured by Sumitomo Chemical Co., Ltd.: melt flow rate 30g/10 min) was used after addition of 3 parts by weight of inorganic chemical foaming master batch (Cellmic MB3072 manufactured by Sankyo Chemical Co., Ltd.) followed by heating and melting at 200°C.

[0035]

The forming process was as follows:

(1) The skin material (30) was placed between the female mold half (23) set at a temperature of 60°C and the male mold half (25) set at a temperature of 30°C; the female mold half (25) was moved and the press was stop when the cavity clearance (t) between the mold halves became 8 mm; the heated molten expandable thermoplastic resin was supplied between the skin material (30) and the male mold half (25) through the resin supply path (32) provided in the male mold half (25); the mold halves were clamped at a compression speed of 10 mm/sec, thereby forming and laminating the skin material (30) and the molten expandable thermoplastic resin core (33) by pressure and

simultaneously forming a skin layer on the surface of the resin. The conditions under which the forming by pressure was performed were pressurizing for 2 seconds at a surface pressure of 5 MPa and a cavity clearance (t) at the time of pressurizing of 2.5 mm.

[0036]

(2) Immediately after the forming by pressure, the female mold half (23) was moved by 1.5 mm in the mold opening direction, whereby the molten core portion in the core material which had not been solidified by cooling was foamed. Cooling was carried out for 50 seconds under the same conditions.

[0037]

(3) In the article removed after the cooling, the thickness of the foamed resin core material was 3.3 mm. The thickness of the skin layer of the core material in the skin material side was 0.2 mm. The thickness of the skin layer in the side opposite to the skin material side was 1 mm. The foamed core layer in the central portion of the core material had a thickness of 2.1 mm and an expansion ratio of 3.5 times. The article was a skin material-integrated laminate that was excellent in soft feel of its skin material and was also excellent in product stiffness.

[Brief Description of the Drawings]

[Fig. 1]

A view showing a partial cross-sectional shape of an

example of the panel-shaped foamed thermoplastic resin article of the present invention.

[Fig. 2]

A view showing an example of a production process of the panel-shaped foamed thermoplastic resin article of the present invention.

[Explanation of Letters or Numerals]

1 Foamed thermoplastic resin article

3 Skin material

5 Skin layer of the skin material side

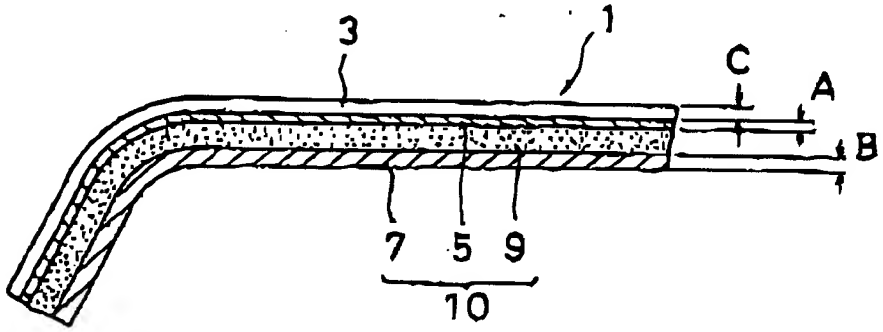
7 Skin layer of the backside

9 Foamed core layer

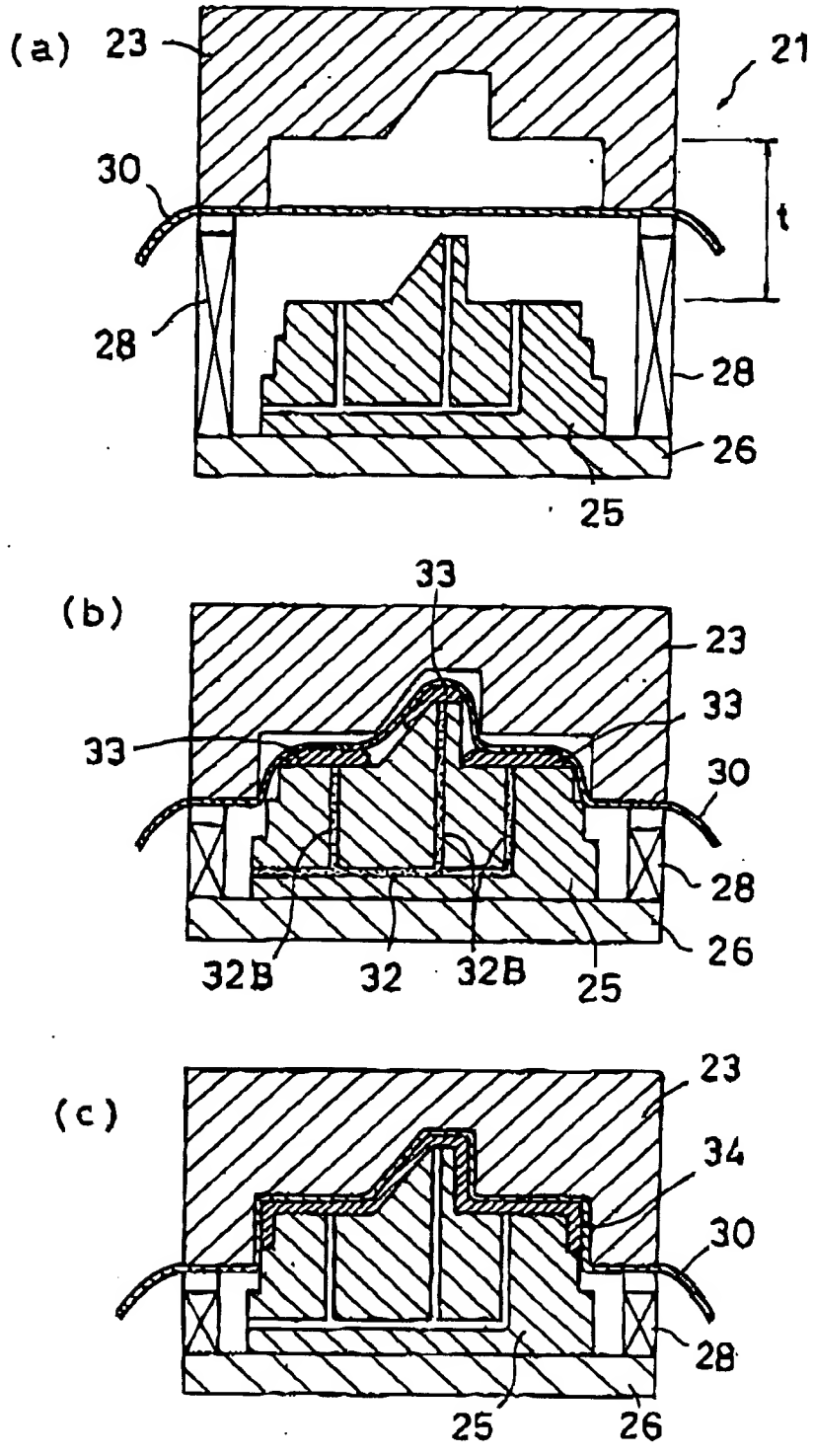
10 Thermoplastic resin foam

[Name of Document] Drawings

[Fig. 1]



[Fig. 2]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[Name of Document] ABSTRACT

[Abstract]

[Problem]

To provide an article comprising a skin material and a foamed thermoplastic resin base material integrally laminated together which has a light weight and a high stiffness wherein the skin material layer has a soft feel.

[Solving Means]

A foamed thermoplastic resin article 1 is provided in which a skin material 3 and a thermoplastic resin foam 10 are integrally laminated together, the thermoplastic resin foam 10 is composed of a foamed core layer 9, a skin layer of the skin material side 5 and a skin layer of the backside 7, and a relationship of A<B is satisfied where the thickness of the skin layer of the skin material side is defined as A and the thickness of the skin layer of the backside is defined as B.

[Drawing Selected] Fig. 1